Surface Coating of Wood Building Products NESHAP (subpart QQQQ) Equations

This document is intended to assist you in calculating your emission rate. These equations are numbered to correspond to the equation numbers in the compliance options diagrams in a separate document entitled "Surface Coating of Wood Building Products NESHAP: Compliance Options.".

$$H_C = \frac{(D_C)(W_C)}{V_S} \quad \textbf{(Equation 1)}$$

Where:

H_C	=	organic HAP content of the coating, grams organic HAP per liter coating solids.
D_C	=	density of coating, grams coating per liter coating.
W_C	=	mass fraction of organic HAP in the coating, grams organic HAP per gram coating.
V_S	=	volume fraction of coating solids, liter coating solids per liter coating.

$$H_e = A + B + C - R_W \quad \textbf{(Equation 2)}$$

Where:

H_e	=	the total mass of organic HAP emissions during the month, grams.
A	=	the total mass of organic HAP in the coatings used during the month, grams, as calculated in Equation 3.
B	=	the total mass of organic HAP in the thinners used during the month, grams, as calculated in Equation 4.
C	=	the total mass of organic HAP in the cleaning materials used during the month, grams, as calculated in Equation 5.
R_W	=	the total mass of organic HAP in waste materials sent or designated for shipment to a hazardous waste TSDF for treatment or disposal during the month, grams. (You may assign a value of zero to R_W if you do not wish to use this allowance.)

$$A = \sum_{i=1}^{m} \left(Vol_{C,i}\right)\left(D_{C,i}\right)\left(W_{C,i}\right) \quad \textbf{(Equation 3)}$$

Where:

A	=	total mass of organic HAP in the coatings used during the month, grams.
$Vol_{C,i}$	=	total volume of coating, i, used during the month, liters.
$D_{C,i}$	=	density of coating, i, grams coating per liter coating.
$W_{C,i}$	=	mass fraction of organic HAP in coating, i, grams organic HAP per gram coating.
m	=	number of different coatings used during the month.

$$B = \sum_{j=1}^{n} \left(Vol_{t,j}\right)\left(D_{t,j}\right)\left(W_{t,j}\right) \quad \textbf{(Equation 4)}$$

Where:

B	=	total mass of organic HAP in the thinners used during the month, grams.
$Vol_{t,j}$	=	total volume of thinner, j, used during the month, liters.
$D_{t,j}$	=	density of thinner, j, grams per liter.
$W_{t,j}$	=	mass fraction of organic HAP in thinner, j, grams organic HAP per gram thinner.
n	=	number of different thinners used during the month.

$$C = \sum_{k=1}^{p} (Vol_{s,k})(D_{s,k})(W_{s,k}) \quad \textbf{(Equation 5)}$$

Where:

C = total mass of organic HAP in the cleaning materials used during the month, grams.
$Vol_{s,k}$ = total volume of cleaning material, k, used during the month, liters.
$D_{s,k}$ = density of cleaning material, k, grams per liter.
$W_{s,k}$ = mass fraction of organic HAP in cleaning material, k, grams organic HAP per gram material.
p = number of different cleaning materials used during the month.

$$V_{st} = \sum_{i=1}^{m} (Vol_{c,i})(V_{s,i}) \quad \textbf{(Equation 6)}$$

Where:

V_{st} = total volume of coating solids used during the month, liters.
$Vol_{c,i}$ = total volume of coating, i, used during the month, liters.
$V_{s,i}$ = volume fraction of coating solids for coating, i, liter solids per liter coating.
m = number of coatings used during the month.

$$H_{yr} = \frac{\sum_{y=1}^{12} H_e}{\sum_{y=1}^{12} V_{st}} \quad \textbf{(Equation 7)}$$

Where:

H_{yr} = the organic HAP emission rate for the 12-month compliance period, grams organic HAP per liter coating solids.
H_e = total mass of organic HAP emissions, grams, from all materials used during month, y, as calculated by Equation 2.
V_{st} = total volume of coating solids used during month, y, liters, as calculated by Equation 6.
y = identifier for months.

$$H_c = (A_c + B_c + C_c - H_{unc})\left(\frac{CE}{100} \times \frac{DRE}{100}\right) \quad \textbf{(Equation 8)}$$

Where:

H_c = mass of organic HAP emission reduction for a controlled coating operation (not using a liquid-liquid material balance) during the month, grams.
A_c = the total mass of organic HAP in the coatings used in the controlled coating operation during the month, grams, as calculated in Equation 9.
B_c = the total mass of organic HAP in the thinners used in the controlled coating operation during the month, grams, as calculated in Equation 10.
C_c = the total mass of organic HAP in the cleaning materials used in the controlled coating operation during the month, grams, as calculated in Equation 11.
H_{unc} = the total mass of organic HAP in the coatings, thinners, and cleaning materials used during all deviations specified in §63.4763(c) and (d) that occurred during the month in the controlled coating operation, grams, as calculated in Equation 12.
CE = the capture efficiency of the emission capture system vented to the add-on control device, percent, as calculated in Equation 13 (if using a liquid-to-uncaptured-gas protocol) or 13b (if using a gas-to-gas protocol).
DRE = organic HAP destruction or removal efficiency of the add-on control device, percent, as calculated in Equation 15.

$$A_c = \sum_{i=1}^{m} (Vol_{c,i})(D_{c,i})(W_{c,i})$$ **(Equation 9)**

Where:

A_c = the total mass of organic HAP in the coatings used in the controlled coating operation, grams.
$Vol_{c,i}$ = total volume of coating, i, used during the month, liters.
$D_{c,i}$ = density of coating, i, grams per liter.
$W_{c,i}$ = mass fraction of organic HAP in coating, i, grams per gram.
m = number of different coatings used.

$$B_c = \sum_{j=1}^{n} (Vol_{t,j})(D_{t,j})(W_{t,j})$$ **(Equation 10)**

Where:

B_c = the total mass of organic HAP in the thinners used in the controlled coating operation during the month, grams.
$Vol_{t,j}$ = total volume of thinner, j, used during the month, liters.
$D_{t,j}$ = density of thinner, j, grams per liter.
$W_{t,j}$ = mass fraction of organic HAP in thinner, j, grams per gram.
n = number of different thinners used.

$$C_c = \sum_{k=1}^{p} (Vol_{s,k})(D_{s,k})(W_{s,k})$$ **(Equation 11)**

Where:

C_c = the total mass of organic HAP in the cleaning materials used in the controlled coating operation during the month, grams.
$Vol_{s,k}$ = total volume of cleaning material, k, used during the month, liters.
$D_{s,k}$ = density of cleaning material, k, grams per liter.
$W_{s,k}$ = mass fraction of organic HAP in cleaning material, k, grams per gram.
p = number of different cleaning materials used.

$$H_{unc} = \sum_{h=1}^{q} (Vol_h)(D_h)(W_h)$$ **(Equation 12)**

Where:

H_{unc} = the total mass of organic HAP in the coatings, thinners, and cleaning materials used during all deviations specified in §63.4763(c) and (d) that occurred during the month in the controlled coating operation, grams.
Vol_h = total volume of coating, thinner, or cleaning material, h, used in the controlled coating operation during deviations, liters.
D_h = density of coating, thinner, or cleaning material, h, grams per liter.
W_h = mass fraction of organic HAP in coating, thinner, or cleaning material, h, grams organic HAP per gram coating.
q = number of different coatings, thinners, or cleaning materials.

$$CE = \frac{\left(TVH_{used} - TVH_{uncaptured}\right)}{TVH_{used}} \times 100 \quad \textbf{(Equation 13)}$$

Where:

CE = the capture efficiency of the emission capture system vented to the add-on control device, Percent, measured using the liquid-to-uncaptured-gas protocol.

TVH_{used} = the total mass of TVH liquid input used in the coating operation during the capture efficiency test run, grams, as calculated in Equation 14.

$TVH_{uncaptured}$ = the total mass of TVH that is not captured by the emission capture system and that exits from the temporary total enclosure or building enclosure during the capture efficiency test run, grams.

$$CE = \frac{TVH_{captured}}{\left(TVH_{captured} + TVH_{uncaptured}\right)} \times 100 \quad \textbf{(Equation 13b)}$$

Where:

CE = the capture efficiency of the emission capture system vented to the add-on control device, percent, measured using the gas-to-gas protocol.

$TVH_{captured}$ = the total mass of TVH captured by the emission capture system as measured at the inlet to the add-on control device during the emission capture efficiency test run, grams, determined according to §63.4765(d)(2).

$TVH_{uncaptured}$ = the total mass of TVH that is not captured by the emission capture system and that exits from the total temporary enclosure or building enclosure during the capture efficiency test run, grams, determined according to §63.4765(d)(3).

$$TVH_{used} = \sum_{i=1}^{n} \left(TVH_i\right)\left(Vol_i\right)\left(D_i\right) \quad \textbf{(Equation 14)}$$

Where:

TVH_{used} = Mass of liquid TVH in materials used in the coating operation during the capture efficiency test run, grams.

TVH_i = mass fraction of TVH in coating, thinner, or cleaning material, i, that is used in the coating operation during the capture efficiency test run, grams TVH per gram material.

Vol_i = total volume of coating, thinner, or cleaning material, i, used in the coating operation during the capture efficiency test run, liters.

D_i = density of coating, thinner, or cleaning material, i, grams material per liter material.

n = number of different coatings, thinners, and cleaning materials used in the coating operation during the capture efficiency test run.

$$DRE = 100 \times \frac{M_{fi} - M_{fo}}{M_{fi}} \quad \textbf{(Equation 15)}$$

Where:

DRE = organic emissions destruction or removal efficiency of the add-on control device, percent.

M_{fi} = the total gaseous organic emissions mass flow rate at the inlet(s) to the add-on control device, grams/hr, using Equation 16.

M_{fo} = the total gaseous organic emissions mass flow rate at the outlet(s) of the add-on control device, grams/hr, using Equation 16.

$$M_f = Q_{sd} C_c (12)(41.6)\left(10^{-6}\right) \quad \textbf{(Equation 16)}$$

Where:

M_f = the total gaseous organic emissions mass flow rate, grams per hour (h).

C_c = the concentration of organic compounds as carbon in the vent gas, as determined by Method 25 or Method 25A, parts per million by volume (ppmv), dry basis.

Q_{sd} = the volumetric flow rate of gases entering or exiting the add-on control device, as determined by Method 2, 2A, 2C, 2D, 2F, or 2G, dry standard cubic meters/hour (dscm/h).

41.6 = conversion factor for molar volume, gram-moles per cubic meter (mol/m^3) (@ 293 Kelvin (K) and 760 millimeters of mercury (mmHg)).

$$H_{CSR} = \left(A_{CSR} + B_{CSR} + C_{CSR}\right)\left(\frac{R_V}{100}\right) \quad \textbf{(Equation 17)}$$

Where:

H_{CSR} = mass of organic HAP emission reduction for the coating operation controlled by the solvent recovery system during the month, grams.

A_{CSR} = the total mass of organic HAP in the coatings used in the coating operation controlled by the solvent recovery system, grams, calculated using Equation 19.

B_{CSR} = the total mass of organic HAP in the thinners used in the coating operation controlled by the solvent recovery system, grams, calculated using Equation 20.

C_{CSR} = the total mass of organic HAP in the cleaning materials used in the coating operation controlled by the solvent recovery system, grams, calculated using Equation 21.

R_V = volatile organic matter collection and recovery efficiency of the solvent recovery system, percent, calculated using Equation 22.

$$H_{HAP} = H_e - \sum_{i=1}^{q}\left(H_{c,i}\right) - \sum_{j=1}^{r}\left(H_{CSR,j}\right) \quad \textbf{(Equation 18)}$$

Where:

H_{HAP} = total mass of organic HAP emissions for the month, grams.

H_e = total mass of organic HAP emissions before add-on controls from all the coatings, thinners, and cleaning materials used during the month, grams, determined by Equation 2.

$H_{c,i}$ = total mass of organic HAP emission reduction for controlled coating operation, i, not using a liquid-liquid material balance, during the month, grams, using Equation 8.

$H_{CSR,j}$ = total mass of organic HAP emission reduction for coating operation, j, controlled by a solvent recovery system using a liquid-liquid material balance, during the month, grams, using Equation 17.

q = number of controlled coating operations not using a liquid-liquid material balance.

r = number of coating operations controlled by a solvent recovery system using a liquid-liquid material balance.

$$A_{CSR} = \sum_{i=1}^{m} (Vol_{c,i})(D_{c,i})(W_{c,i}) \quad \textbf{(Equation 19)}$$

Where:

A_{CSR} = the total mass of organic HAP in the coatings used in the coating operation controlled by the solvent recovery system during the month, grams.

$Vol_{c,i}$ = total volume of coating, i, used during the month in the coating operation controlled by the solvent recovery system, liters.

$D_{c,i}$ = density of coating, i, grams per liter.

$W_{c,i}$ = mass fraction of organic HAP in coating, i, grams per gram.

m = number of different coatings used.

$$B_{CSR} = \sum_{j=1}^{n} (Vol_{t,j})(D_{t,j})(W_{t,j}) \quad \textbf{(Equation 20)}$$

Where:

B_{CSR} = the total mass of organic HAP in the thinners used in the coating operation controlled by the solvent recovery system during the month, grams.

$Vol_{t,j}$ = total volume of thinner, j, used during the month in the coating operation controlled by the solvent recovery system, liters.

$D_{t,j}$ = density of thinner, j, grams per liter.

$W_{t,j}$ = mass fraction of organic HAP in thinner, j, grams per gram.

n = number of different thinners used.

$$C_{CSR} = \sum_{k=1}^{p} (Vol_{s,k})(D_{s,k})(W_{s,k}) \quad \textbf{(Equation 21)}$$

Where:

C_{CSR} = the total mass of organic HAP in the cleaning materials used in the coating operation controlled by the solvent recovery system during the month, grams.

$Vol_{s,k}$ = total volume of cleaning material, k, used during the month in the coating operation controlled by the solvent recovery system, liters.

$D_{s,k}$ = density of cleaning material, k, grams per liter.

$W_{s,k}$ = mass fraction of organic HAP in cleaning material, k, grams per gram.

p = number of different cleaning materials used.

$$R_V = 100 \times \frac{M_{vr}}{\sum_{i=1}^{m} (Vol_i)(D_i)(WV_{c,i}) + \sum_{j=1}^{n} (Vol_j)(D_j)(WV_{t,j}) + \sum_{k=1}^{p} (Vol_k)(D_k)(WV_{s,k})} \quad \textbf{(Equation 22)}$$

Where:

R_V	=	volatile organic matter collection and recovery efficiency of the solvent recovery system during the month, percent.
M_{VR}	=	mass of volatile organic matter recovered by the solvent recovery system during the month, grams.
Vol_i	=	volume of coating, i, used in the coating operation controlled by the solvent recovery system during the month, liters.
D_i	=	density of coating, i, grams per liter.
$WV_{c,i}$	=	mass fraction of volatile organic matter for coating, i, grams volatile organic matter per gram coating.
Vol_j	=	volume of thinner, j, used in the coating operation controlled by the solvent recovery system during the month, liters.
D_j	=	density of thinner, j, grams per liter.
$WV_{t,j}$	=	mass fraction of volatile organic matter for thinner, j, grams volatile organic matter per gram thinner.
Vol_k	=	volume of cleaning material, k, used in the coating operation controlled by the solvent recovery system during the month, liters.
D_k	=	density of cleaning material, k, grams per liter.
$WV_{s,k}$	=	mass fraction of volatile organic matter for cleaning material, k, grams volatile organic matter per gram cleaning material.
m	=	number of different coatings used in the coating operation controlled by the solvent recovery system during the month.
n	=	number of different thinners used in the coating operation controlled by the solvent recovery system during the month.
p	=	number of different cleaning materials used in the coating operation controlled by the solvent recovery system during the month.

$$H_{annual} = \frac{\sum_{y=1}^{12} H_{HAP,y}}{\sum_{y=1}^{12} V_{st,y}} \quad \textbf{(Equation 23)}$$

Where:

H_{annual}	=	the organic HAP emission rate for the 12-month compliance period, grams organic HAP per liter coating solids.
$H_{HAP,y}$	=	the organic HAP emission rate for month, y, determined according to Equation 18.
$V_{st,y}$	=	the total volume of coating solids, liters, used during month, y, from Equation 6.
y	=	identifier for months.